10/18/99

# UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1 53(b))

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|---|---|
| Attorney Docket No. | 1247-0831-3I CONT |
| First Inventor or Application Identifier | PAOLO BARACCHINI |
| Title | THERMOINSULATING MAT OR MINERAL FIBERS WITH RANDOM ORIENTATION |

**APPLICATION ELEMENTS**
*See MPEP chapter 600 concerning utility patent application contents*

*ADDRESS TO:* Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. ■ Fee Transmittal Form (e.g. PTO/SB/17)
(Submit an original and a duplicate for fee processing)

2. ■ Specification Total Pages 10

3. ■ Drawing(s) *(35 U.S.C. 113)* Total Sheets 1

4. ■ Oath or Declaration Total Pages 3
   a. □ Newly executed (original or copy)
   b. ■ Copy from a prior application *(37 C.F.R. §1.63(d))*
   *(for continuation/divisional with box 15 completed)*
      i. □ DELETION OF INVENTOR(S)
      Signed statement attached deleting inventor(s) named in the prior application, see *37 C.F.R §1.63(d)(2) and 1.33(b).*

5. ■ Incorporation By Reference *(usable if box 4B is checked)*
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4B, is considered to be part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

**ACCOMPANYING APPLICATION PARTS**

6. ■ Assignment Papers Recorded @ Reel/Frame 6631/0053
7. □ 37 C.F.R. §3.73(b) Statement *(when there is an assignee)* □ Power of Attorney
8. □ English Translation Document *(if applicable)*
9. □ Information Disclosure Statement (IDS)/PTO-1449 □ Copies of IDS Citations
10. □ Preliminary Amendment
11. ■ White Advance Serial No. Postcard
12. □ Small Entity Statement(s) □ Statement filed in prior application. Status still proper and desired.
13. □ Certified Copy of Priority Document(s)
*(if foreign priority is claimed)*
14. ■ Other: REQUEST FOR PRIORITY

15. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below:*
■ Continuation □ Divisional □ Continuation-in-part (CIP) of prior application no.: 08/218,295.
*Prior application information:* Examiner: Shelborne Group Art Unit: 1504

16. Amend the specification by inserting before the first line the sentence:
■ This application is a ■ Continuation □ Division □ Continuation-in-part (CIP)
of application Serial No. 08/218,295 Filed on March 28, 1994, which is a continuation of application serial no. 08/001,208, filed January 6, 1993, abandoned, which is a continuation of application serial no. 07/631,086 filed December 19, 1990, abandoned.

□ This application claims priority of provisional application Serial No. Filed

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TITLE OF THE INVENTION

# THERMOINSULATING MAT OF MINERAL FIBERS WITH RANDOM ORIENTATION

## BACKGROUND OF THE INVENTION

Processes for production of thermoinsulating mats or felts of mineral fibers (glass fibers or rock fibers) whose orientation is almost random, as described in European patent 0 133 083, are already known. These products have advantageous qualities, but they have a high density (from 50 to 150 kg/m3) and do not have a sufficient flexibility for some applications, in particular for applying such insulating mats to cylindrical surfaces, e.g., of tanks, without forming pockets of condensation on the side in contact with the cylindrical surface and without forming cracks in their outside surface.

## SUMMARY OF THE INVENTION

This invention has as an object to provide a product having the qualities required for the above applications.

It has unexpectedly been found that by reducing the diameter of the fibers very appreciably, relative to the known fibers, a product having the desired qualities and a density clearly lower than that of similar known products can be produced.

This invention comprises a thermoinsulating mat of mineral fibers having a quasi-random orientation in which the great majority of fibers have a diameter between 2.5 and 4.5 micrometers and a length from 2 to 15 cm and in which the mat has a density not greater than 40 kg/$m^3$.

## BRIEF DESCRIPTION OF THE DRAWINGS

By way of example, an embodiment of the mat according to the invention will now be described with reference to the accompanying drawing which shows, by way of example, how the mat according to the invention can be produced. The drawing schematically shows an installation for the production of a thermoinsulating mat of mineral fibers having a quasi-random orientation according to the invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Known mats of mineral fibers having a quasi-random orientation are formed from glass or rock fibers having a diameter of 6 to 14 micrometers and a length of several centimeters. According to the invention, the mat is formed by much finer mineral fibers having, for the great majority of them, an average diameter of 2.5 to 4.5 micrometers and a length of 2 to 15 cm.

How an insulating mat having the desired qualities indicated above can be produced with such a material will now be described.

In a conventional way, the felts of mineral fibers are continuously formed by placing on a conveyor fibers which are conveyed by gas streams. The conveyor holds the fibers and allows the gases to pass.

Before they are placed on the conveyor, the fibers are coated with a resinous composition intended to bind the fibers to one another, thus giving cohesiveness to the felt which is formed. The resinous composition, applied in liquid form, is crosslinked by a heat treatment performed on the felt previously brought to the desired thickness and density.

The forming of felts by deposition of fibers on the reception conveyor, or on a similar element, leads to a tangling of the fibers which is not homogeneous in all directions. Instead it has been experimentally found that the fibers have a strong tendency to be placed parallel to the reception surface. This tendency is all the more pronounced as the fibers are longer.

In the installation shown in the drawing, the fibers arrive in the form of a mat 1 which is then subjected, as will be explained, to a double crimping which is achieved at two places. This mat first passes into an upstream section formed as two zones Ia and IIa which have different sections. A zone IIIa forms a downstream section from which the mat having nonpolymerized glue thereon is conducted to a polymerization oven (not shown).

The mat or felt of glass fibers (or other mineral fibers) arrives at 1 with nonpolymerized glue thereon and passes, with

an initial speed which is the same as that of an upstream conveyor, between a pair of conveyors 2, 2'.

After exiting conveyors 2, 2' of zone Ia, the felt arrives on pair of conveyors 3, 3' of zone IIa, having a much lower speed than that of conveyor 1,2', which produces a longitudinal compression of the product and a first crimping, as illustrated in the drawing.

After exiting conveyors 3, 3', the felt, crimped a first time, arrives between pair of conveyors 4, 4' of zone IIIa, having a lower speed than that of conveyors 3, 3'. This results in a second compression of the product between conveyors 4, 4' and a second crimping being given to the final product, as well as in a completely random arrangement of fibers, as shown in the drawing.

Then, the product arrives at a pair of conveyors 5, 5', which make the felt pass into a polymerization oven (not shown).

The direction of movement of the felt is indicated by arrow 6'.

Due to the double crimping and the use of fine fibers, a product is obtained having a lower apparent density (LAD) and a greater flexibility, making it suitable, for example, for use in the thermal insulation of large tanks in the open air, by winding on the periphery of these tanks.

Concrete examples of various values (speeds of various conveyors and input and output heights of some conveyors) will now be given.

The first longitudinal compression produced by the passage of the felt through conveyors 2, 21 of zone Ia to conveyors 3, 3' of zone IIa is achieved by giving to the latter a speed which is, for example, 2.5 times lower than that of the conveyors of zone Ia. This produces the undulated structure visible in the drawing.

The second longitudinal compression is obtained by giving conveyors 4, 4' of zone IIIa a speed which is, for example, 2.5 times lower than that of the conveyors of zone IIa. This produces a random and homogeneous structure.

Speed $v_1$ of conveyors 2, 2' of zone Ia is equal to the input speed of the felt in 1. The latter is adjusted to obtain the desired ratio of speeds (or of crimping).

The speed of conveyors 4, 4' of downstream zone IIIa is equal to the speed of conveyors 5, 5' bringing the felt to the oven, which avoids any accidental packing or decrimping during the passage of the mat from zone IIIa to the oven.

The speed of the conveyors of zone Ia is equal to input speed $v_r$ of the felt in 1.

The speed of the conveyors in zone IIa is, for crimping, calculated as a function of the ratio of input speed vr of the felt to speed under study $v_c$, therefore $v_r/v_c$ (crimping speed), is:

$$\text{Vzone IIa} = \frac{Vr}{\sqrt{Vr/Vc}}$$

The adjustment of the thicknesses of the felt takes place as follows:

Upstream section, zones Ia and IIa

if H'1 is the input height in the conveyor of zone Ia,

if H'2 is the output height of the conveyors of zone IIa,

if Ee is the final thickness of the mat, selected according to the desired apparent density (LAD),

then:

H'1 = (1.2 to 2.3) . Ee;

H'2 = (1.3 to 2.4) . Ee;

Downstream section, zone IIIa;

if H'3 is the input height between conveyors 4 and 4',

if H'4 is the output height between conveyors 4 and 4',

then:

H'3 = (1.0 to 1.30) . Ee;

H'4 = (1.0 to 1.20) . Ee;

Conveyors 3, 3' and 4, 4' oppose an increase in the thickness of the mat under the effect of the axial pressure that it undergoes.

The two sections, upstream (Ia and IIa) and downstream (IIIa), are mechanically connected to one another and are placed on a traveling path making possible the positioning of their unit relative to the oven.

Each conveyor is equipped with a conveyor belt driven by a dc geared motor unit making possible a precise adjustment of the speeds to the desired values.

Thanks to the fineness of the fibers and to the completely random arrangement of the insulation fibers in the finished product, the latter has a compact surface, a good flexibility and a constant thickness with good insulation qualities.

The application of the product to large plane or nonplane (concave or convex) surfaces is easy. The product offers a resistance to compression which is sufficient to make it possible to apply on it a protective coating or a layer of additional insulation. The product can be in the form of a felt roll, lending itself well to the application to the outside face of a fire-resistant coating and to cylindrical surfaces.

The product thus obtained exhibits the following characteristics:

-- random or quasi-random distribution of the fibers (glass or rock fibers),

-- great fineness of the fibers (diameters of 2.5 to 4.5 micrometers),

-- length of the fibers of 2 to 15 cm,

-- apparent density (LAD) less than or equal to 40 $kg/m^3$,

-- resistance to compression (for a crushing of 10%) greater than or equal to 0.5 $kN/m^2$,

-- heat conductivity coefficient less than or equal to 0.040 W/mK.

The final mat can have a thickness of 20 to 200 mm.

The mat can have a further surfacing, i.e., it can be coated with one or two adherent sheets of paper, aluminum, polyethylene or PVC.

The random distribution of the fine fibers used assures, during the winding of the mat around a cylindrical surface, that this winding is performed without deformation of the inside and outside surfaces, which are thus perfectly cylindrical with good application on the element to be insulated, avoiding any pockets of condensation of the inner side and any cracks of the outer side.

WHAT IS CLAIMED AS NEW AND DESIRED TO BE SECURED BY LETTERS PATENT OF THE UNITED STATES IS:

1. Thermoinsulating mat of mineral fibers having a quasi-random orientation, comprising fibers, a great majority of which have a diameter between 1.5 and 4.5 micrometers and a length of 2 to 15 centimeters, wherein the mat has a density not greater than 40 $kg/m^3$.

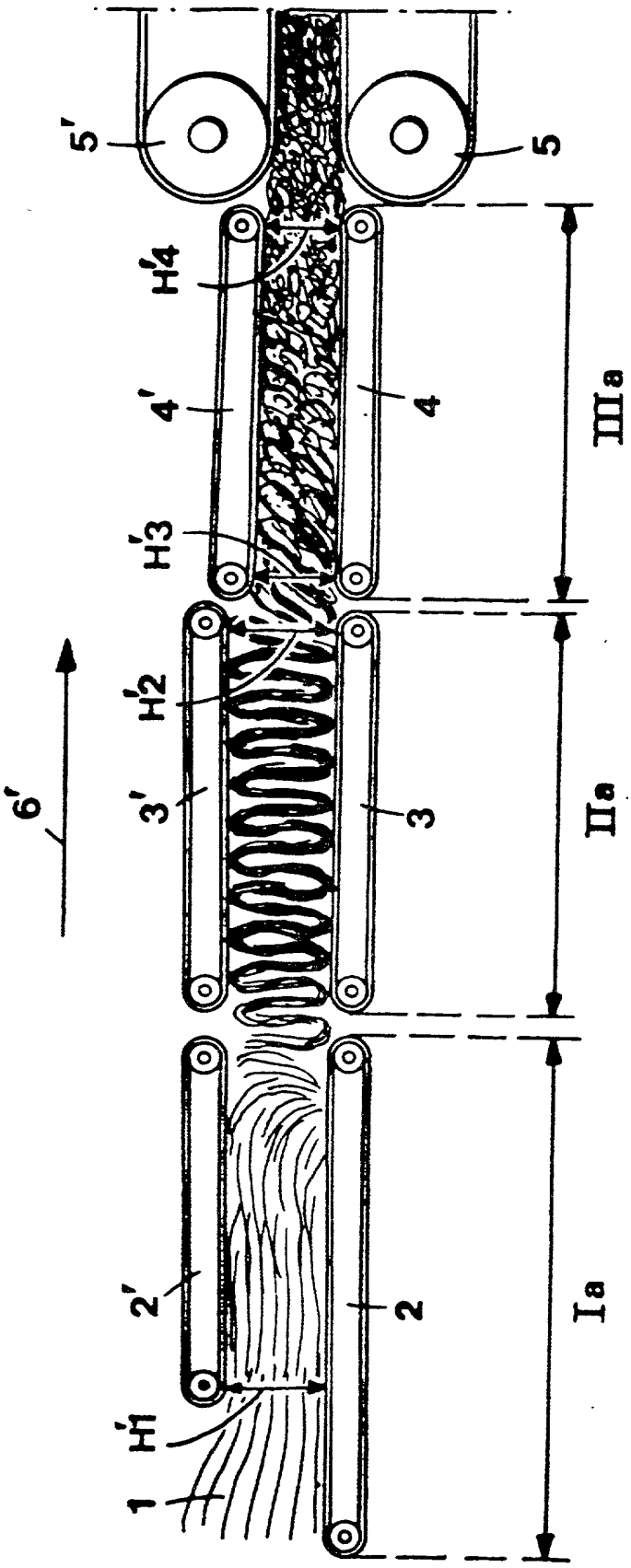
2. Mat according to claim 1, wherein the mat has a resistance to compression, for a crushing of 10%, at least equal to 0.5 $kN/m^2$.

3. Mat according to claims 1 or 2, wherein the mat has a heat conductivity coefficient not greater than 0.040 W/mK.

4. Mat according to one of claims 1 or 2, formed by a double crimping of a layer of mineral fibers.

ABSTRACT OF THE DISCLOSURE

A mat of mineral fibers has a random or quasi-random fiber orientation. The fibers have diameters which, for the great majority of them, are 2.5 to 4.5 micrometers, and a length of 2 to 15 cm. Its density is less than 40 $kg/m^3$. Its resistance to compression, for a crushing of 10%, is equal to at least 0.5 $kN/m^2$. The fineness of the fibers and their random distribution imparts to the mat an exceptional lightness and an excellent flexibility, making possible the perfect application of the mat on cylindrical surfaces.


5'
5
H'4
4'
4
IIIa
H'3
H'2
6'
3'
3
IIa
2'
2
Ia
H'1
1

# Declaration, Power Of Attorney and Petition



WE (I) the undersigned inventor(s), hereby declare(s) that:

My residence, post office address and citizenship are as stated below next to my name,

We (I) believe that we are (I am) the original, first, and joint (sole) inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention entitled

THERMOINSULATING MAT OF MINERAL FIBERS WITH RANDOM ORIENTATION

the specification of which

☐ is attached hereto.

☒ was filed on DECEMBER 19, 1990 as Attorney Docket ~~Application Serial~~ No. 1247-322-3I

and amended on _____.

☐ was filed as PCT international application

Number _____

on _____,

and was amended under PCT Article 19

on _____ (if applicable).

We (I) hereby state that we (I) have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

We (I) acknowledge the duty to disclose information material to the examination of this application in accordance with Section 1.56(a) of Title 37 Code of Federal Regulations.

We (I) hereby claim foreign priority benefits under Section 119 of Title 35 United States Code, of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

| Application No. | Country | Day/Month/Year | Priority Claimed |
|---|---|---|---|
| 4567/89 | SWITZERLAND | 19/12/1989 | ☒ Yes ☐ No |
| 1809/90 | SWITZERLAND | 29/05/1990 | ☒ Yes ☐ No |
| | | | ☐ Yes ☐ No |
| | | | ☐ Yes ☐ No |

We (I) hereby claim the benefit under Section 120 of Title 35 United States Code, of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Section 112 of Title 35 United States Code, We (I) acknowledge the duty to disclose material information as defined in Section 1.56(a) of Title 37 Code of Federal Regulations, which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

| Application Serial No. | Filing Date | Status (pending, patented, abandoned) |
|---|---|---|
| | | |
| | | |
| | | |

And we (I) hereby appoint: Norman F. Oblon, Registration Number 24,618; Marvin J. Spivak, Registration Number 24,913; C. Irvin McClelland, Registration Number 21,124; Gregory J. Maier, Registration Number 25,599; Arthur I. Neustadt, Registration Number 24,854; Robert C. Miller, Registration Number 25,357; Richard D. Kelly, Registration Number 27,757; James D. Hamilton, Registration Number 28,421; Eckhard H. Kuesters, Registration Number 28,870; Robert T. Pous, Registration Number 29,099; Charles L. Gholz, Registration Number 26,395; Vincent J. Sunderdick, Registration Number 29,004; William E. Beaumont, Registration Number 30,996; Steven B. Kelber, Registration Number 30,073; Stuart D. Dwork, Registration Number 31,103; Robert F. Gnuse, Registration Number 27,295; and Jean-Paul Lavalleye, Registration Number 31,451, our (my) attorneys, with full powers of substitution and revocation, to prosecute this application and to transact all business in the Patent Office connected therewith; and we (I) hereby request that all correspondence regarding this application be sent to the firm of OBLON, SPIVAK, McCLELLAND, MAIER & NEUSTADT, P.C., whose Post Office Address is: Fourth Floor, 1755 Jefferson Davis Highway, Arlington, Virginia 22202.

We (I) declare that all statements made herein of our (my) own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Date

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Citizenship:
Post Office Address:

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Signature of Inventor

Date

Residence:
Citizenship:
Post Office Address:

NAME OF FIFTH JOINT INVENTOR

Signature of Inventor

Date

Residence:
Citizenship:
Post Office Address: